

# openBISmantic: Improving the interoperability of MSE (meta)data stored in the data management platform openBIS through semantic web technologies

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In the era of the increasing digitalization of many laboratory processes and the advance of data-driven methodology in materials science and engineering (MSE), researchers are in need of digital systems that enable them to document their work in a standardised manner, provide generic as well as domain-specific context information (so-called metadata), and store, manage, and share associated data. The open-source platform openBIS is an example of such frameworks, combining a repository for (meta)data storage with a graphical user interface for inventory management and an electronic lab notebook [1]. Being a highly customizable, user-friendly platform, the use of openBIS in the MSE community has increased over the past three years. Several research groups within the Fraunhofer Group MATERIALS and at the Bundesanstalt für Materialforschung und -prüfung (BAM) are successfully using openBIS to document experimental and computational workflows in different MSE domains, e.g., for mechanical specimen preparation, tensile- and fatigue testing, and metallography, as well as for more complex procedures such as the synthesis and characterization of nanomaterials. To streamline the development of openBIS-related tools, the working group “openBISmantic” has been established within the interinstitutional project Mat-o-Lab [2].

Within openBIS, physical and intangible assets are represented by user-defined entity types whose instances can be connected by directed links, thus enabling provenance tracking. Datasets are attached to the metadata entities, which are themselves embedded within a hierarchical folder structure that allows for the flexible management of access privileges. While export mechanisms for data and metadata in openBIS exist, the resulting format currently does not allow for easy import or querying. The use of institute- or research group-specific constantly evolving and possibly conflicting metadata schemes further complicates data sharing across different openBIS instances and/or to public databases, hindering the open and FAIR exchange of data and metadata.

The working group openBISmantic aims at improving openBIS data interoperability for MSE. We apply linked open data concepts to design and implement a plugin for the transformation of (meta)data exported from individual openBIS instances into a semantic triple data model (i.e., according to the Resource Description Framework; RDF) [3]. This allows researchers from various MSE domains to use their institutes’ openBIS instances to describe complex experimental processes via linked entities according to a chosen metadata scheme or domain ontology. Researchers can benefit from this targeted export functionality in a number of scenarios. First, they can export all associated entities and underlying schemes by marking the desired (meta)data. The metadata will then be transformed into triples and mapped to a lightweight application ontology based on the openBIS hierarchy. Second, associated datasets can be published in open data repositories and referenced by their identifiers. Third, (meta)data from different openBIS instances can be integrated in an RDF triplestore, a graph database that allows users to uncover information on materials experiments through semantic queries, thus simplifying the data exchange between heterogeneous sources and ultimately fostering data reuse and scientific reproducibility.

## References

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